TECHNICAL MEMORANDUM

To:	Robin Campbell, President, Coal Association of Canada
Cc:	Bob Bell (Montem Resources), Beth McCallum (Ovis), Andy Caruso (Atrum Coal), John W. Parkhill (Mancal Coal), Ken Brophy (Ram River Coal), Kyle Hobbs (Westmorland Coal)
From:	Guy Gilron, Senior Environmental Scientist, Borealis Environmental Consulting Inc.
Subject:	Review Comments on: "Water quality in the McLeod River as an indicator for mining impacts and reclamation success (2005-2016)" (Redmond, 2021)
Date:	August 6, 2021.

A. INTRODUCTION

During discussions between the Coal Association of Canada (CAC) and the Coal Policy Committee (CPC) as part of stakeholder consultations regarding Alberta's 1976 Coal Policy, reference was made to a recently-released Alberta Environment and Parks (AEP) report entitled: "Water quality in the McLeod River as an indicator for mining impacts and reclamation success (2005-2016)"[1] (the "report"). The context relates specifically to the potential success of the reduction of selenium concentrations over time, as a result of long-term reclamation efforts, in a region of Alberta that hosted historical metallurgical coal mines (*i.e.*, the McLeod River watershed).

Guy Gilron of Borealis Environmental Consulting Inc. (Borealis) – who participated in the above-mentioned discussions, and who has expertise in this area - was retained by the CAC to review the report, with a specific focus on aspects related to selenium, to evaluate, and provide a professional opinion on, the significance of its results and conclusions. This technical memorandum summarizes the results of this review.

B. SUMMARY OF REPORT SCOPE AND CONTENTS

The Redmond (2021) report presents and evaluates water quality data (based on monitoring efforts[2]), and discusses comparisons of upstream and downstream water quality in historical coal

[1]Redmond, L.E. 2021. Water quality in the McLeod River as an indicator for mining impacts and reclamation success (2005 to 2016). Government of Alberta, Ministry of Environment and Parks. ISBN 978-1-4601-4982-9. Available at: http://open.alberta.ca/

[2]Unclear whether industry or government (or both) conducted the monitoring.

mining areas in the McLeod River watershed, including its tributaries (*i.e.,* Luscar Creek and Gregg River).

Water quality monitoring data from the watershed provide an opportunity to assess water quality trends downstream of both scenarios - historical and current mining activity (*i.e.,* from various periods between 2005 and 2016). An indirect scope of the report relates to the potential effectiveness of reclamation efforts at sites downstream of the mines. Activity at the Cheviot mine has impacts on the McLeod River, whereas reclamation activity at the closed Luscar and Gregg River mines[3] have changed water quality conditions in the McLeod River tributaries (*i.e.,* Luscar Creek and Gregg River). Where possible, trends in surface water quality parameters were assessed over time in relation to changes in water quality and associations were made in connection with active/recent mining and reclamation activity.

Again, as indicated above, this review focussed specifically on selenium, which has – during the CPC consultations - attracted concern from stakeholders, related to potential impacts of proposed coal mining in the Eastern Slopes, and throughout Alberta.

C. REVIEW COMMENTS

The review comments provided below are listed in three categories, specifically: overall evaluation of report's significance, major comments and minor comments.

C-1. Overall Evaluation of Report's Significance

The most important aspect of the review of this report is addressing the question: "do the results of the monitoring data and associated comparative analyses, support the assertion that reclamation efforts have affected downstream water quality (selenium), and if so, how?"

- First and foremost, the report indicates that the analysis makes: "connections…..between the impacts of mining over time and the progress of reclamation processes in the watershed", based on "indicators of these impacts and successes", specifically:
    - *"water quality parameters that had significant **increasing** trends downstream of active mining may be good indicators of mining impacts"; and,*
    - *"similarly, water quality parameters that had significant **decreasing** trends downstream of reclamation activities may be early indicators of reclamation success."*

Borealis commentary: Although the analyses are made on a "macro scale", this is reasonable for an initial assessment. However, additional information is required to understand the significance of the results (*e.g.,* magnitude of increases/decreases in selenium concentrations, correlation with biological/ecological effects (and/or fish tissue concentration benchmarks), other confounding variables, such as sulphate).

[3]Luscar mine closed in 2003; Gregg river mine closed in 2000.

- Based on a significant increasing trend in selenium in the McLeod River downstream of Cheviot mine from 2005 to 2016, the Redmond report (2021) assumes that this indicates 'impacts' from mining activity[4].

Borealis commentary: As indicated below (see **Major Comments** section), exceedance of water quality guidelines, does not – in itself – represent an impact; a better understanding of adverse biological/ecological effects (and/or comparisons to fish tissue benchmarks) needs to be demonstrated, to support this assertion.

- Redmond (2021) concludes that downstream of active mining on the McLeod River and of reclamation activities downstream of tributaries (*i.e.*, Luscar Creek and the Gregg River), it was observed that concentrations of selenium and other mining-related chemicals (*i.e.*, metals (antimony, molybdenum and uranium) and nitrogen compounds), **decreased** subsequent to the termination of mining activity; the author speculates that this may indicate reclamation success.

Borealis commentary: As indicated above, a better understanding of adverse biological/ecological effects (and/or comparisons to fish tissue benchmarks) needs to be demonstrated, to support this assertion.

- The report indicates that elevated selenium concentrations downstream of active mining in the watershed is supported by previous studies/reports (*i.e.*, Casey & Siwik, 2000; Casey, 2005). Selenium concentrations downstream of reclamation activities have decreased <u>but are still elevated above reference conditions and above aquatic life guidelines</u>.

Borealis commentary: Agreed, and this is not unusual, as selenium is often elevated in areas in which there is mining activity. What is important here is the relative magnitude of elevated concentrations 'above reference conditions' and 'aquatic life guidelines'. Guidelines are generally conservative, and therefore exceedance of guidelines do not necessarily indicate risk of adverse impacts.

- Redmond (2021) further recommends that:
    - *"water quality be sampled simultaneously with flow data so flow-adjusted trends can be assessed at all sites;*
    - *monitoring programs should account for seasonality in water quality data; and,*
    - *an adaptive monitoring program will allow for enhanced site selection to account for the delineation of impacts and tracking the trajectory of trends found in this report."*

Borealis commentary: Agreed. This is reasonable, scientifically defensible, and will help to support all of the previously-outlined assertions and conclusions.

[4]It should be noted that other mining-related parameters (*e.g.*, metals (mainly), nitrogen compounds and total dissolved solids) also increased, which supports this position.

- Redmond (2021) concludes that: *"Further research is required to assess the impacts of elevated levels of variables and their use as indicators of mining activity and reclamation progress. Measures to assess the use of indicators at the regulatory level before entering the receiving waters should be investigated."*

Borealis comment: Again, as above, this is reasonable, scientifically defensible, and will help to support all of the previously-outlined assertions and conclusions.

C-2. Major Comments

- It is apparent from the data presented in the report, that selenium concentrations – even in those waterbodies in which they have decreased - may exceed those in reference areas and aquatic life guidelines. However, relative to other areas in Canada in which elevated selenium is a greater concern (*e.g.*, the Elk Valley watershed in BC), the concentrations downstream of areas of historical mining activities in the McLeod River watershed (i.e., <15 ug/L) are in a range in which fish population impacts are unlikely. The latter assertion is based on Borealis' experience with data from many sites across western Canada, a recent CAC technical proposal developed for Environment and Climate Change Canada (ECCC) in relation to the proposed *Coal Mining Effluent Regulations (CMERs*), and an upcoming publication (*i.e.*, Gilron *et al*., 2021; in press). Moreover, in order to evaluate the potential impacts of these elevated water-based concentrations, an evaluation of fish tissue concentrations in resident species is warranted, as tissue concentrations (vs water-based concentrations) are a more accurate indicator of risk/effects (Janz *et al*., 2010).

- The report often refers to water quality "impacts"; it is assumed that – in this context - the author is likely referring to the exceedance of water quality guidelines. Exceedance of water quality guidelines, in itself, however, is does not constitute an impact. An impact (or an effect) should refer to observed or demonstrated adverse effects on individuals, populations or overall ecological health.
    - An example of how this can mislead is as follows: "The Luscar Creek and Gregg River sites allowed for a simple upstream versus downstream comparison (*i.e.*, Control-Impact design)….." This simple comparison does not necessarily indicate that comparisons of these sites indicate a cause-effect relationship; more information is required to confirm that (see below).

- The report indicates that: "Water quality monitoring has occurred in this region by the provincial government for nearly 30 years as a way to assess watershed health and the effect of point and non-point sources". It is unclear where these data can be found; there is no reference to the source of these monitoring data (see Gilron & McKenna, 2021). It is Borealis' understanding that this information is not available, but should be, given that this a publicly-funded, government program.

- There are many statements in the report that are speculative, and not based on scientific studies (*e.g.*, "Native rainbow trout populations may be more vulnerable to elevated Se if

there are additional stressors on fish habitat. For example, the historic stocking of non-native brook trout (that are less sensitive to Se) may further contribute to the displacement of native rainbow trout in the Eastern Slopes of Alberta (Rasmussen & Taylor, 2009). In addition, high selenium concentrations from coal mining may also impair recruitment of other fish species, such as the bull trout, listed as a species of concern in Alberta (Palace *et al.*, 2004)."

  - Is there a connection between these statements and the Holm *et al.* (2005) and Miller *et al.* (2003) studies? If so, more detail is required to support the comparison.

- Throughout the methods section, there is no indication of which personnel (and which laboratories) conducted the sample collection (and analyses), respectively. Did AEP and/or Alberta Energy Regulator (AER) staff (or contractors) conduct all field work? Were provincial government (or commercial) analytical labs used to conduct the chemical analyses? Given the time period covered by the evaluation in this report, it is possible that changes in sample collection and analyses may have affected the quality/integrity of the data.
  - The Redmond (2021) report should include an Appendix with a list of labs and a description of the analyses technique(s).

- It is stated that: *"…..statistical variance among different laboratory analytical methods. For example, if a variable had two different laboratory methods over time, and there was equal variance for those methods, the data was (sic) combined"*; and, *"Using this method, no data was (sic) removed from the water quality database. Changing methodology over time can influence trend analysis, so this method limits the risk of bias due to laboratory changes."*
  - How was this variability addressed in the evaluation/assessment?

- In the Methods subsection, Site Selection:
  - it does not appear that reference condition is properly characterized (i.e., 1 reference site comparing to 4 exposed sites and 1 far-field site). This needs to be discussed further.
  - …..from 2011-2016, no trend analysis was conducted but surface water quality guideline exceedances and summary information were assessed. This type of assessment – without trend analysis - does not allow for tracking of reclamation success over time.

- There wasn't an evaluation conducted to address trends in sulphate (in this case, dissolved sulphate) and selenium (total) at Station M2 (see Tables 3 and 5)? Sulphate is a toxicity-modifying factor for selenium, so this should be considered, when evaluating the potential for adverse effects/risks of selenium.

C-3. Minor Comments

- Throughout the report, selenium is referred to as a metal. This is not correct. Selenium is considered a metalloid (https://www.britannica.com/science/selenium), since it does not have characteristics of metals.

- Selenium levels/concentrations are characterized with the qualifiers “high”, “low”, “elevated”, “reduced”, however, values are not provided. Given the fact that the difference between essentiality and toxicity with respect selenium concentrations is in a very small concentration range, it is crucial that these values be quantified and reported, and when possible, contextualized in relation to effects thresholds, regulatory guidelines, and other benchmarks.

D. SUMMARY

This review set out to address the fundamental question in relation to selenium dynamics in the McLeod River watershed: “do the results of the monitoring data and associated comparative analyses, support the assertion that reclamation efforts have affected downstream water quality (selenium), and if so, how?”

Considering that there are various methodological and practical issues that need to be addressed/resolved, as an initial assessment, the Redmond (2021) report provides a reasonable evaluation of potential mining impacts and reclamation success, based on trend analyses and relative increases/decreases of selenium concentrations over time.

Per the author’s conclusions, with which Borealis concurs, further recommendations need to be addressed, and further research is required in order to support these initial results and conclusions, with an aim at understanding whether reclamation activities (e.g., mitigation efforts, advancement of treatment options, etc.) can influence selenium concentrations downstream of coal mining areas.

E. CLOSURE

We trust that this information meets your requirements at the present time. Please do not hesitate to contact the undersigned at your convenience to discuss any aspects of this Technical Memorandum.

Sincerely,

BOREALIS ENVIRONMENTAL CONSULTING INC.

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